Biological_control_microbial_final

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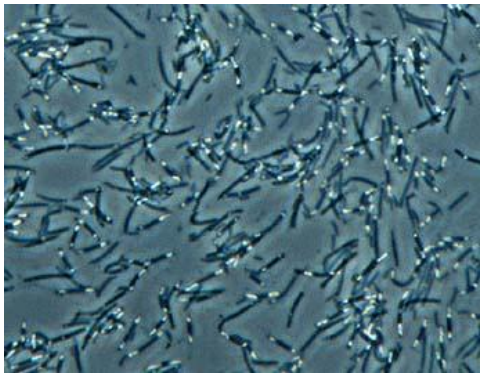
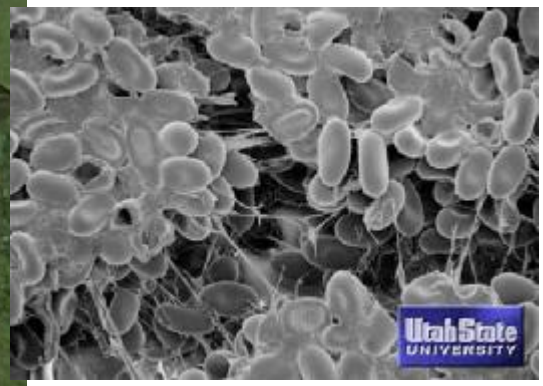
1. **Pathogens**
2. The **Microbial control : Definition**
3. Microbial insecticides
4. Microbial control
5. *Bacillus thuringiensis*
6. Structure/Function of Bt
7. Viruses
8. Fungi
9. Nematodes
10. Protozoa

Pathogens





- Bacteria
- Fungi
- Viruses
- Nematodes
- Protozoa

Pathogens

- Usually very specific
- leave a trail of bodies
- may take a few days to provide control (lag time)
- kill, reduce reproduction, reduce insect health

Pathogens

- Survive longer in the field but have low virulence
- Biological alternative to chemical insecticides

The **Microbial control**

- The use of pathogens or parasites to control pests is also called microbial control.
- Unlike mites and insects, antagonist microorganisms rarely reproduce in the environment, creating stable populations.
- Because of this, they must be considered and dealt with on the fields as “biological insecticides or Microbial insecticides ”.

The Pathogens - bacteria, viruses, fungi, protozoa and parasites (particularly nematodes)

- True parasites, such as parasitic nematodes, differ from parasitoids in that they do not kill their host, they only weaken and debilitate them.
- Despite this, they have proved useful control agents, to the extent that there now exist a number of commercial companies involved in the culture and sale of nematodes for the control of garden and horticultural pests.

ADVANTAGES

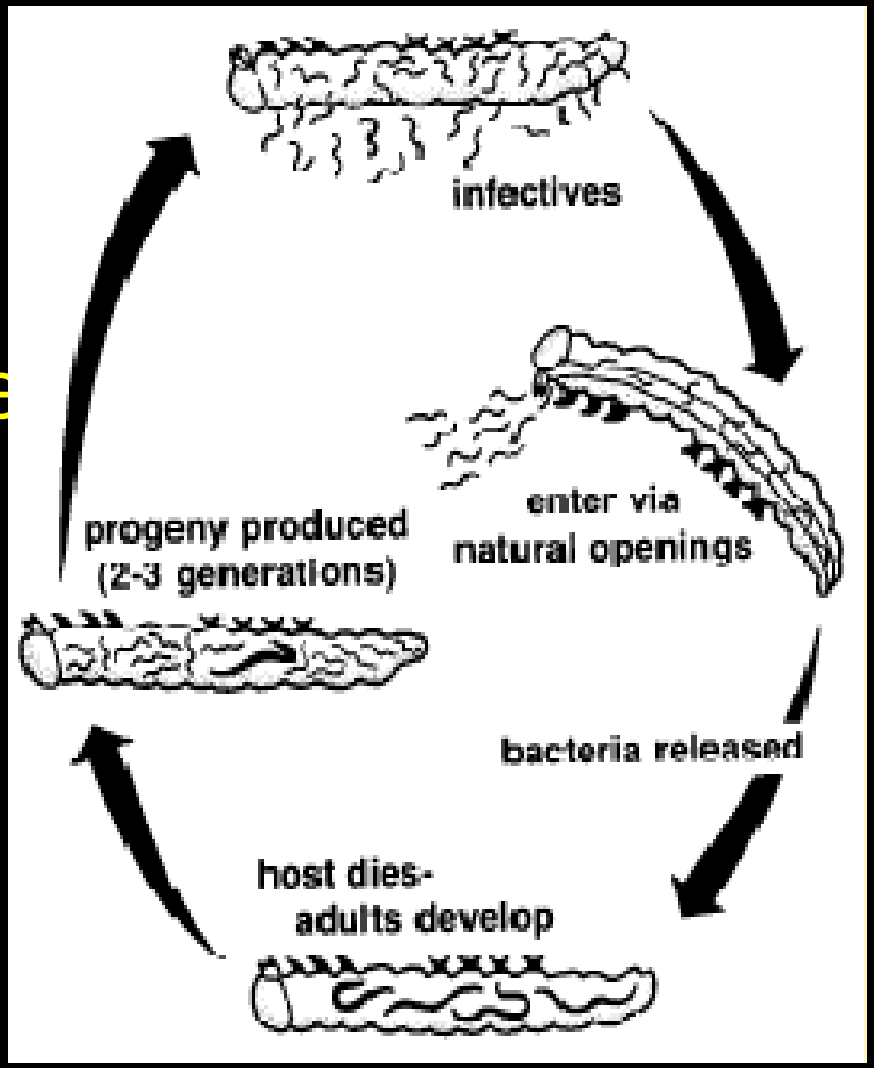
1. Effective!
2. safe for plants, humans and animals
3. no resistance
4. no negative influence on yield
5. environmental friendly
6. no re-entry restrictions in crop
7. no harvest interval

Beneficial (entomopathogenic) nematodes

Steinernema feltiae, Steinernema carpocapsae, Heterohabditis bacteriophora

Beneficial (entomopathogenic)nematodes

- natural enemies of *insect larvae*
- live in symbiosis with insect lethal bacteria
- only infectious juvenile stage is free living;
- Other stage inside insect
- finds, penetrate and kills in 24-48 hours



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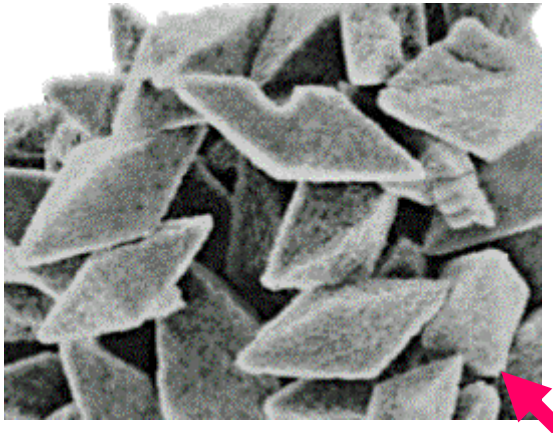
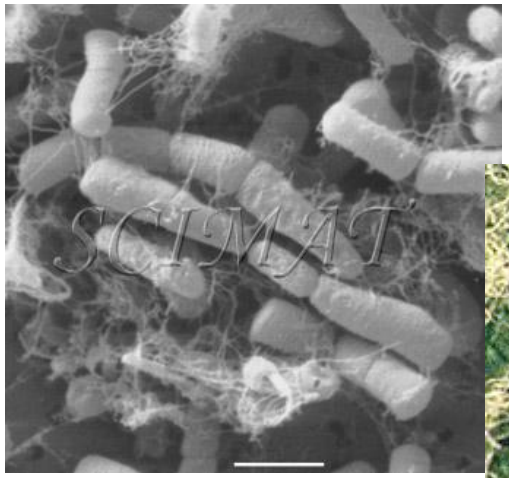
Bacteria

Out of all, *Bacillus thurigiensis* is the most used

- 1921: reported in Japan.
- 1940s: Commercial prep. Available in France
- 39% of biopesticides
- Lep, Dip and Colep strains



Crystals containing poison



Bacillus thuringiensis

- Microbial insecticides account for only a 1.6% share of the world insecticide market,
- but 95 % of these sales involve products based on isolates of the bacteria *Bacillus thuringiensis*

- The most famous and diffused pathogenic microorganism is *Bacillus thuringiensis*. It is an aerobic, spore-forming bacterium, of which various strains are available (*kurstaki, aizawai, israeliensis* and *tenebrionis*).
- These strains differ in the specificity of their activity
- on lepidopterous larvae (*kurstaki, aizawai)* with some specific activities),
- on the larvae of some mosquitos (*israeliensis*) and on *Leptinotarsa decemlineata* larvae (*tenebrioni*).

QUESTION

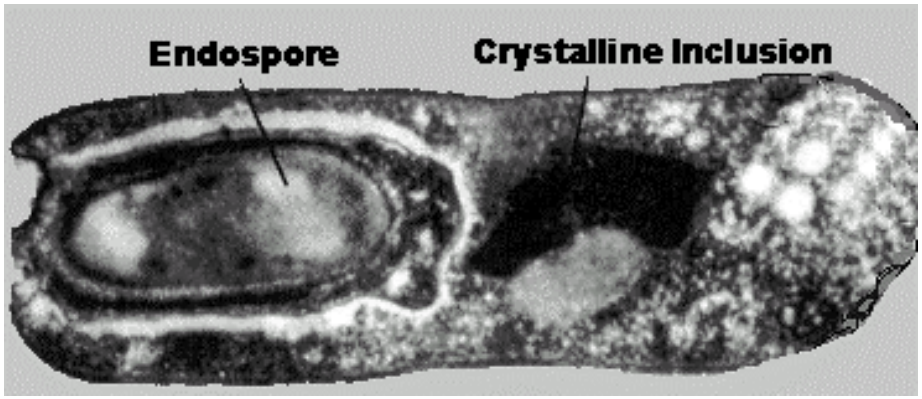
Do the Bt strains differ in the specificity of their activity (*kurstaki, aizawai, israeliensis* and *tenebrionis*

ANSWER

1. on lepidopterous larvae (*kurstaki, aizawai)*
2. on the larvae of some mosquitos (*israeliensis*)
3. on *Leptinotarsa decemlineata* larvae (*tenebrionis*).

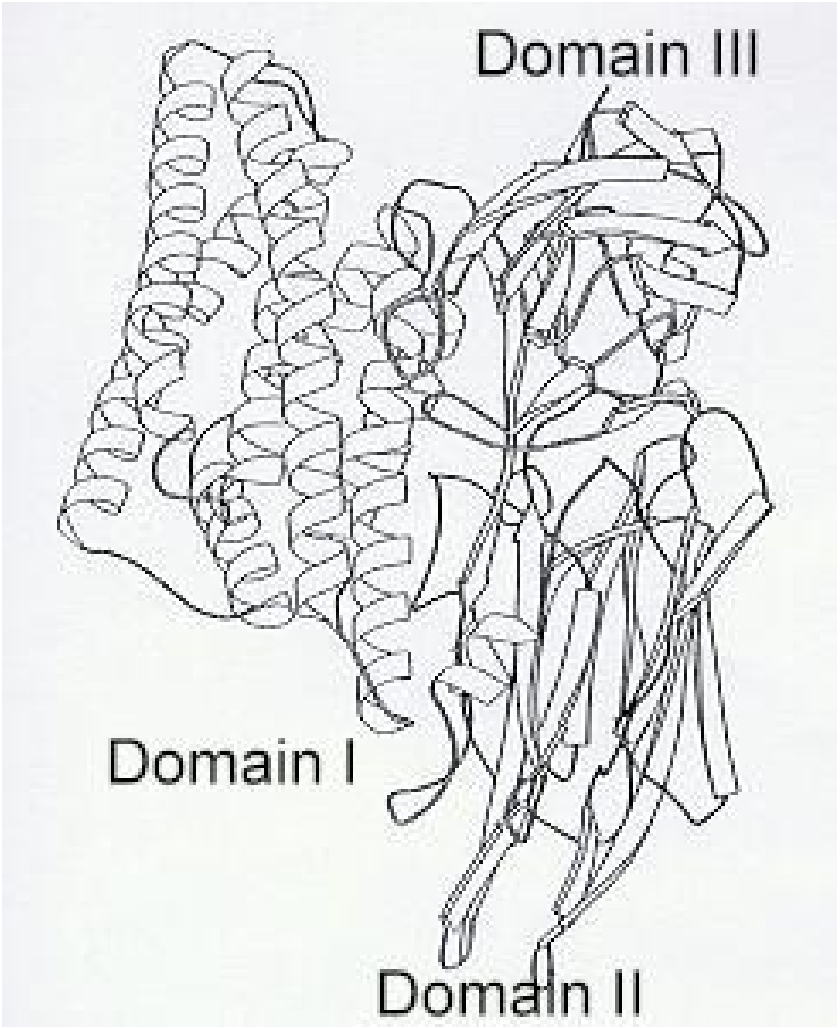
Structure / Function of Bt

- Structure:
  - Bt forms spore and crystal protein inclusion that consist of δ-endotoxins
  - 3 domains of the cry protein



- Mode of Action…
  - Kills by Collodial Osmotic Lysis

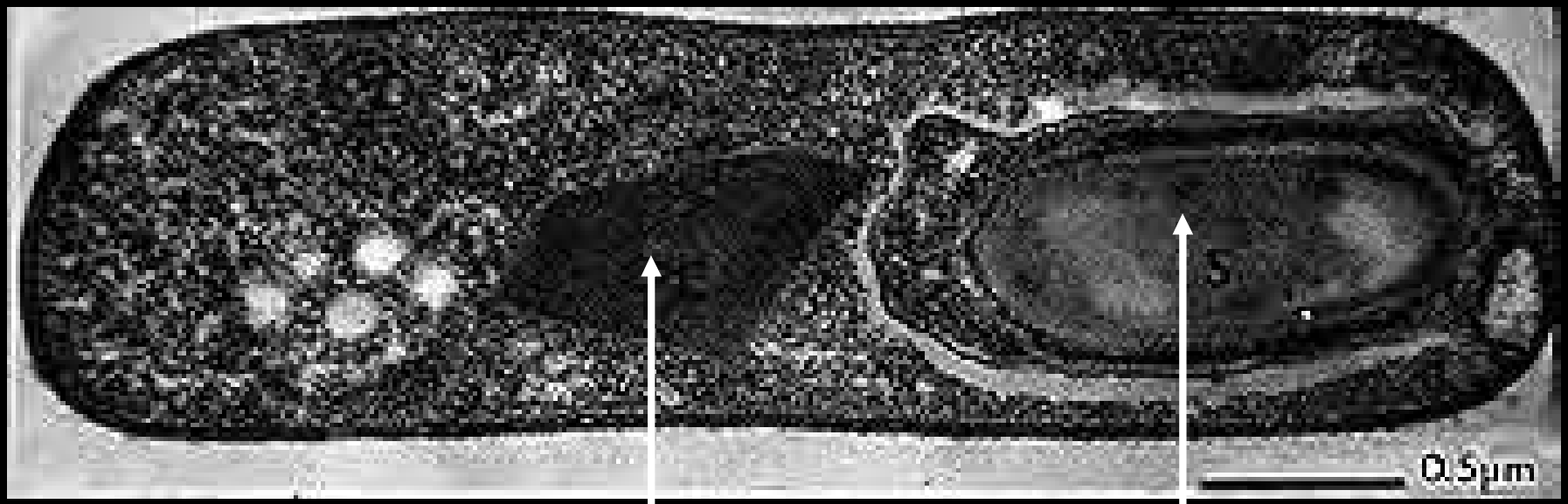
Cry Protein Structure



- Domain 1 = responsible for inserting into the gut membrane and creating a pore where ions can pass freely
- Domain 2 = responsible for binding to the receptors on the epithelial lining of the midgut
- Domain 3 = responsible to protect the endotoxin from cleavage by gut proteases, or may be involved in ion channel formation, receptor binding, and insect specificity

Microbial control

Bacillus thurigiensis



toxic crystal

Spores

Structure/Function of Bt

- This "microbial" insecticide consists of spores and crystals produced by a soil-inhabiting bacterium.
- When certain insect species ingest these spores and crystals, the digestive tract becomes paralyzed and the insects stop feeding, become sick, and die in four to seven days.
- During sporulation, the microorganism produces a toxin that interacts with the glycoproteins of the insect's intestinal cells, blocking the muscles of the digestive apparatus and interrupting the nutritional process.

- This is especially useful for controlling cabbageworms and a few other species of caterpillars that damage garden crops.
- The selectivity of *Bacillus thuringiensis* is very elevated and it is fully effective when it is used in the first larval stages.

QUESTION

1. Does the Bt works as a selective insectide?
2. when it is used
3. Is it effective for the insect borers ?

ANSWER

1. The selectivity of *Bacillus thuringiensis* is very elevated
2. it is fully effective when it is used in the first larval stages
3. NO, it is effective only for the insects that are exposed on the surface of the plant (leaves)

- ***Bacillus Thuringiensis*** commonly referred to as **"B.t.",** is marketed under the trade names **Dipel, Thuricide, Bactucide** and others.
- In commercial products, usually only the toxin which acts exclusively through ingestion, is present.
- To be effective, it is therefore necessary that the insect feeds for some time on the surface of the plant that has been treated.

QUESTION

1. Does the Bt cause a disease (epizooty) in the larvae?
2. Which is the insecticide factor of Bt
3. Does the Bt effective for the insects with sucking pierce mouthparts? JUSTIFY your answer

ANSWER

1. NO
2. TOXIN
3. To be effective, it is therefore necessary that the insect feeds for some time on the surface of the plant that has been treated.

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Viruses

- Out of 6 groups only 3 are safe:

  -Nuclear Polyhedrosis Virus (NPV)

  -Granulosis visus (GV)

  -Citoplasmic Polyhedrosis Virus (CPV)

- Family Specific
- Need to be ingested

- **Virus diseases of insects** and their role in the natural regulation of insect populations have been recognized for many years
- There are three types of virus that are entomopathogenic, are considered harmless to humans, and are sufficiently virulent for use as control agents;
- the nuclear polyhedrosis viruses (NPV),
- the granulosis viruses (GV)
- and the cytoplasmic polyhedrosis viruses (CPV).

- Of these only the NPVs and GVs are widely used.
- Many highly specific entomopathogenic viruses are known, which generally infect the insect when it is in its larval stage and act through ingestion.
- Their action is not immediate, so the infected insects are still able to feed for some time, causing further damages.

QUESTION

1. Advadages and Disadvadages of viruses as insect control agents

ANSWER

1. Advadages highly specific entomopathogenic
2. Disadvadages The Their action is not immediate, so the infected insects are still able to feed for some time, causing further damages

- The most commonly used virus is the granulosis virus, active on *Cydia pomonella*.
- However, other microorganisms, active on different species of phytophagous insects, are also available.
- Commercial preparations of *Spodoptera exigua* NPV have been registered for the control of S. *exigua*, a pest of potted plants and cut flowers, ornamentals and vegetables in the Netherlands and NPVs of *Neodiprion sertifer*, *Lymantria dispar*,

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Fungi

- Can penetrate cuticle

VERTICILLIUM LECANII

Aphids infested by VERTICILLIUM LECANII

Fig. 3. Particolare della sporulazione di *V. lecanii* su afide

Nematodes

- Three important families:

  - Steinenermatidae
  - Heterorhabditidae
  - Mermithidae

- Useful for soil and bark insects